

Office Action Summary

Application No.

09/440,794

Applicant(s)

BAILEY III ET AL.

Examiner

Matthew A. Anderson

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 February 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 31-45 and 49-56 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 31-45 and 49-56 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 15 November 1999 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Examiner's Amendment

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephonic interview with Raymond Mahboubian on 2/25/2003.

In respect to claim 31 as it appears in paper #16, replace the last word of claim 31, "direction", with "substrate".

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 31-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lymberopoulos et al. (US 6,085,688) in view of Hills et al. (US 6,217,786 B1).

Lymberopoulos et al. discloses a method of and apparatus for producing a plasma for use in manufacturing microelectronics including dry (i.e. gas phase) etching of semiconductor wafers. The chamber shown in Fig 5 is azimuthally symmetric around the center. The chamber holds the plasma as it is ignited and during the processing of the wafer since there is no separate plasma generation chamber. A window is disclosed in column 6 lines 8-35. The Rf antenna (i.e. a coil is shown in Fig. 5 as 110) is disposed above the plane defined by the wafer (i.e. substrate). Electromagnets (150a and 150B in Fig. 5) are disposed above the wafer. The magnets are disclosed as independently controllable conductors in the abstract and are used to control the plasma density and prevent non-uniform charge build-ups. By magnetically controlling the uniformity of charge distribution, one of ordinary skill in the art would expect the uniformity of the etching to be controlled. This reads on the changing of the variation in the magnetic field to improve processing uniformity across the substrate. The wafer is placed in the chuck at the bottom of the reaction chamber and gas is flowed in to form a plasma. In col. 10 lines 1-8, the control of the plasma density throughout the chamber from the workpiece to the inductive window and antenna is suggested. The relationship of the magnetic fields to the plane of the substrate to be etched is shown in the Figs. including that numbered 11. Clearly the magnetic field need not be perpendicular to the substrate surface. In col. 7 lines 24-31 is described the control of the magnetic field to directly control the plasma density near the workpiece surface.

Lymberopoulos does not explicitly disclose dc power to the electromagnets but dc is a known power supply configuration. Lymberopoulos is silent as to the gas used in the etching process.

Hills et al. discloses etching a wafer and an oxide on that wafer using specified gases including fluorocarbons and inert carrier gases with Rf plasma (a dry etching process). The specific fluorocarbons of C₂F₆, C₃F₆ and C₄F₈ or mixtures thereof were disclosed as were the carrier gases of Ar, He, Ne, Kr, Xe, or mixtures thereof. These read on the two or more gases of the form C_xF_yH_zO_w as defined in the spec lines 19-21 on page 30). Oxygen and nitrogen gases as well as the hydrogen-containing additive gases CH₄, H₂, H₂O, NH₃ were also optionally present.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the method disclosure of Lymberopoulos et al. with that of Hills et al. because Lymberopoulos et al. discloses a Rf powered plasma etch process and chamber and Hills et al. discloses a etching gas useable in a Rf powered plasma processing chamber.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to, in a chamber configured as disclosed in claim 31, to control the magnetic field in the region proximate the antenna to improve the processing uniformity across the substrate because Lymberopoulos et al. discloses such magnetic control in an etching process and such control would have been anticipated to produce an expected result of process uniformity.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to flow the claimed listed gases into such an Rf plasma processing chamber because these gases were known to Hills et al. for Rf processing and their use would have been anticipated to produce the expected result of dry plasma etching.

4. Claims 36-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lymberopoulos et al. and Hills et al. as applied to claims 31-35 above, and further in view of Kondo (US 6,254,966).

Lymberopoulos et al. and Hills et al. are described above.

Kondo et al. discloses a supporter for recording mediums which is made of (see col. 17 lines 55+) glass (a.k.a. amorphous silicon dioxide). The etching of the supporter is performed by dry etching. Plasma is known to those of ordinary skill as a dry etching process since gases are used to form the excited species therein. The gases used to etch include CHF_3 , CF_4 , C_2F_6 , C_3F_8 , NF_3 , SF_6 , C_2F_4 , C_3F_6 , C_4C_8 , C_4F_{10} , C_5F_8 , C_6F_{14} , $\text{C}_3\text{F}_6\text{O}$, C_9F_{10} , CF_3Br , CF_3I , $\text{C}_2\text{F}_5\text{I}$, CF_2Cl_2 , CFCl_3 , CH_2F_2 , C_2HF_5 , $\text{C}_2\text{H}_2\text{F}_4$, $\text{C}_2\text{H}_4\text{F}_2$, $\text{C}_2\text{H}_3\text{F}_3$, C_3HF^7 , CF_3 , $\text{C}_2\text{H}_2\text{F}_3$, $\text{C}_8\text{H}_3\text{F}_5$, Cl_2 , CCl_4 , SiCl_4 , BCl_3 , PCl_3 , CCl_3F , BBr_3 , CH_2Cl_2 , and mixed gases thereof and other mixed gases containing oxygen, hydrogen, argon, He, N_2 , Ne, Ar, Kr, Xe, O_3 , CO, CO_2 , H_2O , CH_4 , C_2H_6 , C_3H_8 , C_4H_{10} , C_2H_4 , C_3H_6 , C_4H_8 , C_2H_2 , and C_3H_4 .

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine Kondo et al. with the previous cited references because Kondo et al. provides a more complete discussion of the gases used in plasma (i.e. dry etching) applications for etching silicon oxide.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the claimed listed gases in a plasma etching process because the claimed listed gases were known for plasma etching and their use in such an environment would have been anticipated to produce an expected result.

5. Claims 42-45, 49-53, 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lymberopoulos et al. and Hills et al. as applied to claims 31-35 above, and further in view of Lu (EP 0821397 A2).

Lu et al. discloses a composite SiC that is used to form the chamber wall, chamber roof, collar around the wafer, grounding plane, and window for Rf radiation. The SiC is described as useful for reducing flaking (page 6 lines 35+). The surface after etching was smooth. This suggests little interaction of the material and the plasma. And, as table 2 shows, the etch rate of the SiC was less than the commonly used quartz or Si. The SiC was described as made from a layer of CVD SiC composite bonded to a free standing SiC wall formed from such methods as sintering or hot pressing. The bulk wall was described as grounding in 40-45.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to form the processing chamber from a material such as a composite SiC that does not substantially react with the reactive gases flown into the processing chamber and forms a ground because such a SiC chamber is suggested by Lu et al. and that such a material was not substantially reactive with Rf plasmas. The examiner notes this reads on a chamber made entirely of SiC since Lu et al discloses walls roof and Rf window made of SiC. Additionally, the examiner argues that the apparatus

limitations do not affect the process in a manipulative sense and therefore do not have weight in the process claims. There is not a manipulative effect since SiC walls are taught by Lu et al. and one of ordinary skill would expect this material to react to the same plasma conditions in a similarly.

Claim Rejections - 35 USC § 112

6. Claim 31 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification does not supply support for the newly added limitation "...wherein said different radial locations include at least one radial region which is not in an axial direction perpendicular to said substrate." The applicant has not specified where support for this negative limitation is found.

Response to Arguments

7. Applicant's arguments filed 2/19/2003 have been fully considered but they are not persuasive.

Concerning the non-convincing arguments concerning the magnetic field control disclosed by Lymberopoulos et al., the examiner points to the disclosure therein (fig. 11

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and col. 7 lines 24-31 which suggests the direction of the magnetic field control and thus plasma density control need not be perpendicular to the substrate.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). The gases chemistries used for Rf plasma processing of a substrate are suggested as described above. Lymberopoulos et al. suggests control of magnetic fields to control plasma density and uniformity during processing of substrates. Motivation for the combination were given above.

As to the argument that two or more gases were not suggested by the references, (in particular Hills et al.), this is not convincing. Col. 4 lists 3 specific fluorocarbons and specifies mixtures thereof (lines 58-59).

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

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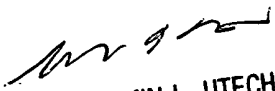
mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew A. Anderson whose telephone number is (703) 308-0086. The examiner can normally be reached on M-Th, 6:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

MAA
April 9, 2003


BENJAMIN L. UTECH
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700



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